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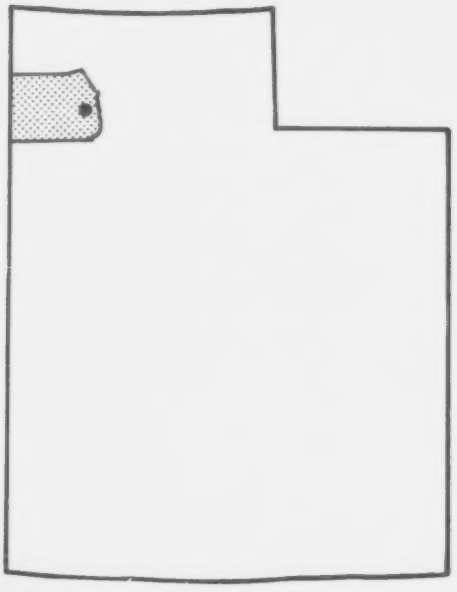
FLOOD INSURANCE STUDY

CITY OF TOOELE, UTAH
TOOELE COUNTY



SEPTEMBER 29, 1989

Federal Emergency Management Agency

COMMUNITY NUMBER - 490145

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	4
	2.4 Flood Protection Measures	5
3.0	ENGINEERING METHODS	5
	3.1 Hydrologic Analyses	6
	3.2 Hydraulic Analyses	7
4.0	FLOODPLAIN MANAGEMENT APPLICATIONS	8
	4.1 Floodplain Boundaries	8
	4.2 Floodways	8
5.0	INSURANCE APPLICATION	9
6.0	FLOOD INSURANCE RATE MAP	9
7.0	OTHER STUDIES	9
8.0	LOCATION OF DATA	10
9.0	BIBLIOGRAPHY AND REFERENCES	10

TABLE OF CONTENTS cont'd

Page

FIGURES

Figure 1 - Vicinity Map 3

TABLES

Table 1 - Summary of Discharges 6

EXHIBITS

Exhibit 1 - Flood Profiles

Settlement Canyon	Panels 01P - 07P
Middle Canyon Creek	Panels 08P - 13P
Unnamed Canyon	Panels 14P - 15P
Unnamed Canyon Tributary	Panel 16P
Unnamed Canyon No. 2	Panel 17P

Exhibit 2 - Flood Insurance Rate Map Index
Flood Insurance Rate Map

Exhibit 3 - Elevation Reference Marks

FLOOD INSURANCE STUDY
CITY OF TOOELE, TOOELE COUNTY, UTAH

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the the City of Tooele, Tooele County, Utah, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Geological Survey (USGS) for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-85-E-1823. This study was completed in March 1988.

1.3 Coordination

An initial community coordination meeting was held on June 3, 1985, to determine the flooding sources to be studied and the method of analysis to be used to study each source.

On December 14, 1988, the results of this study were reviewed and accepted at a final coordination meeting attended by representatives of the community and FEMA.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Tooele, Tooele County, Utah. The area of study is shown on the Vicinity Map (Figure 1).

The following areas were studied by detailed methods:

Settlement Canyon:
From approximately 200 feet downstream of the Tooele Ordinance Depot Road upstream to approximately 900 feet upstream of the Settlement Canyon Dam; a distance of approximately 17,200 feet

Middle Canyon Creek:
From approximately 1,050 feet upstream of State Highway 36 upstream to approximately 1,250 upstream of Third North Street; a distance of approximately 13,750 feet

Unnamed Canyon:
From approximately 280 feet upstream of Second South Street to approximately 230 feet upstream of Skyline Avenue; a distance of approximately 2,600 feet

Unnamed Canyon Tributary:
From the confluence with Unnamed Canyon to approximately 500 feet upstream of Skyline Avenue; a distance of approximately 1,000 feet

Unnamed Canyon No. 2:
From approximately 120 feet downstream of Buzianis Road to approximately 2,200 feet upstream of Buzianis Road

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through March 1992.

2.2 Community Description

The City of Tooele is located in the northeastern part of the northeastern quarter of Tooele County, which is located in northwestern Utah. Tooele, which is the county seat, is situated in the Tooele Valley at the western base of the north-south Oquirrh Mountain Range and is located approximately 10 miles south of the Great Salt Lake.

Tooele is accessible by State Routes 36 and 112 and is situated approximately 7 miles northeast of the community of Stockton, 10 miles southeast of Grantsville, and 27 miles southwest of Salt Lake City, the State capital.

Tooele is primarily a residential community with commercial development mainly along the north-south State Highway 36 (Main

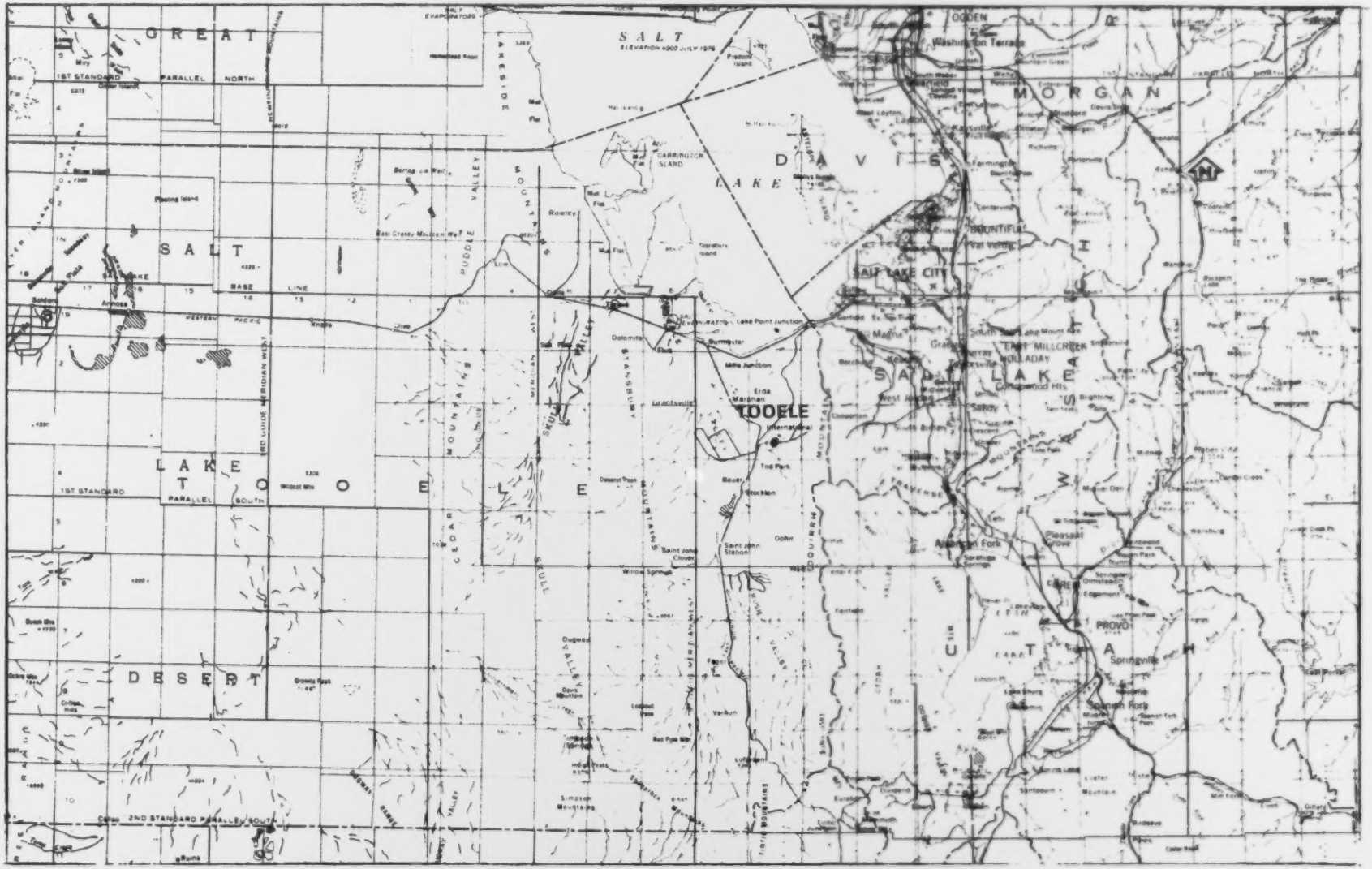


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

Street) and expanding on both sides of the highway to about First East and First West Streets (Reference 1).

As of 1980, the population for the City of Tooele was 14,335, which is an increase of 14.3 percent over the 1970 population of 12,539 (Reference 2).

2.3 Principal Flood Problems

Flood problems in the City of Tooele are due primarily to four stream sources: Settlement Canyon, Middle Canyon Creek, Unnamed Canyon, and Unnamed Canyon No. 2. These streams originate in the Oquirrh Mountains immediately southeast of Tooele and they flow, in general, in a northwesterly direction.

The natural flood hazards are the typical shallow channels found on alluvial fans and slopes sufficiently steep to cause eroding velocities to occur. Thus, floodflows tend to overtop the main channel banks and develop new channels. These flood hazards are more prevalent in Settlement Canyon within the city than in other drainage areas.

Historically, maximum floods of record have occurred during the April through June snowmelt period and have resulted in prolonged periods of high flows varying from a few days to several weeks. Cloudburst type floods and floods resulting from combined general rain storms and melting snow are also common. The three maximum floods of record (1960-74) on Settlement Canyon at the discontinued crest-stage partial-record station (No. 1017290) located about 3.5 miles south of Tooele are:

Date	Discharge	Recurrence Interval
August 11, 1968	67 cfs	5 years
June 24, 1969	155 cfs	16 years
June 1, 1973	125 cfs	11 years

Recent flooding in 1983 and 1984 occurred from snowmelt in Settlement Canyon and Middle Canyon Creek. the greatest flooding of 1983-84 occurred in 1984 when peak flows at Tooele were approximately 123 cfs (cubic feet per second) in Settlement Canyon and 200 cfs in Middle Canyon Creek at respective recurrence intervals of 6 years and 26 years. The flooding from the two streams caused damage to the culinary water system in Middle Canyon Creek and to streets, culverts, and surface-water collection facilities in the city. Flood waters in the Settlement Canyon natural drainage channel were directed down a diked street in southwest Tooele. The factors that aggravated the flood problems were debris deposits, overtopped flood channels, constructive culverts, and floodplain development. In 1984, damage assessments totaled over $2 million (Reference 3), which included the cost of removing debris and emergency protection works.

2.4 Flood Protection Measures

The city has enlarged existing waterways on Settlement Canyon and Middle Canyon Creek; however, for 100-year floods, the flood-protective measures provide only a small degree of protection for streets and private homes, this is the situation particularly in the Settlement Canyon runoff areas where urban development has occurred. In the Settlement Canyon drainage, Settlement Canyon Reservoir is located between the mountains and the city at the south corporate limits. Its storage capacity of 987 acre-feet (Reference 4) significantly reduces debris deposits in drainage channels and streets in the city, but it is not effective in reducing the peak flow. For peak flow less than the 100-year flood, the reservoir has spilled before the peak flow occurred even when the reservoir was drained before high flow began. Immediately downstream from State Highway 36, the floodflow is diverted from the natural drainage, about one-fourth of the flood water would be routed into an underground 3-foot diameter concrete trapezoidal channel. About 600 feet downstream from the beginning of the trapezoidal channel, the flood water enters the floodway on Fifth Street that runs to the west side of the city. Then the flood waters enter a manmade channel which continues to the corporate limits. The manmade waterways would be overtopped by the 100-year flood, thus, resulting in overland flows in the urban areas. In Middle Canyon Creek, a concrete culvert-drop structure has been constructed at the intersection of Droubay Road and Third North Street to eliminate flooding over the road; however, the 10-year flood would overtop the left bank immediately upstream of the structure and cause water to flow across the intersection and west along Third North Street.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the

community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The 100-year peak flows were determined utilizing procedures outlined in USGS Water Resources Investigations Report (WRIR) 83-4129.

For Settlement Canyon, a weighted 100-year peak flow was computed at the discontinued crest-stage partial-record station, located 3.5 miles south of Tooele, using the adjusted station peak flow-frequency relation for the period of 1960-74 and results from the regional regression equations reported in WRIR 83-4129. This weighted flow was then transferred to immediately below the Settlement Canyon Reservoir using the transfer equation in WRIR 83-4129 (Reference 5).

These same regional regression equations were used to determine the 100-year floods from Middle Canyon Creek, Unnamed Canyon, Unnamed Canyon Tributary, and Unnamed Canyon No. 2.

Peak discharge-drainage area relationships for the City of Tooele, Tooele County, Utah are shown in Table 1.

TABLE 1. SUMMARY OF 100-YEAR DISCHARGES

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Settlement Canyon below Settlement Canyon Reservoir	17.3	*	*	400	*
Middle Canyon Creek at cross Section "P"	12.0	*	*	330	*
Unnamed Canyon below Unnamed Canyon Tributary	1.21	*	*	77	*
Unnamed Canyon at elevation 5,320 ft	.95	*	*	66	*
Unnamed Canyon No. 2 at elevation 5,320 ft	.38	*	*	37	*
Unnamed Canyon Tributary at elevation 5,320 ft	.22	*	*	26	*

*not determined

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the riverine sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments where a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Field surveys were made for valley cross sections above and below culvert, weir, diversion, and drop structures and for road cross sections to compute the significant backwater effects of these hydraulic structures. Additional valley cross sections were run between the hydraulic structures to define extremes in the channel conveyances. Several cross sections were synthesized from adjacent surveyed valley cross sections to improve the definition of the water-surface elevation profiles. All hydraulic structures on the streams studied in the city were surveyed to obtain elevation data and structural geometry.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen based on engineering judgment and field observations of the floodplain areas. The roughness coefficients for the channels ranged from 0.015 to 0.058 and for the overbank areas from 0.032 to 0.055.

Water-surface elevations for floods of selected recurrence intervals on each stream studied by detailed methods were computed by the Water Surface Profile (WSPRO) step-backwater computer program developed by the USGS for the Federal Highway Administration (Reference 6). In stream reaches of supercritical flow, the flood profiles were plotted at critical depth. The starting water-surface elevations for each step-backwater run was determined by the critical-depth procedure (Reference 6), when supercritical flow was identified, or by computation of the water-surface elevation at approach sections to a culvert (Reference 7), weir, or flow-over-the-road (Reference 8).

The hydraulic analyses for this study are based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing sound floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the streams studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using the USGS 7.5-minute topographic quadrangle map for the City of Tooele, enlarged from a scale of 1:24,000 to 1:12,000, with a contour interval of 20 feet (Reference 9).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones AE) Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. Floodways were not computed for this study because it is a limited detail study.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplains, and the locations of selected cross sections used in the hydraulic analysis.

7.0 OTHER STUDIES

This study is authoritative for the purposes of the NFIP. Data presented herein either supersede or are compatible with all previous determinations.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225.

9.0 BIBLIOGRAPHY AND REFERENCES

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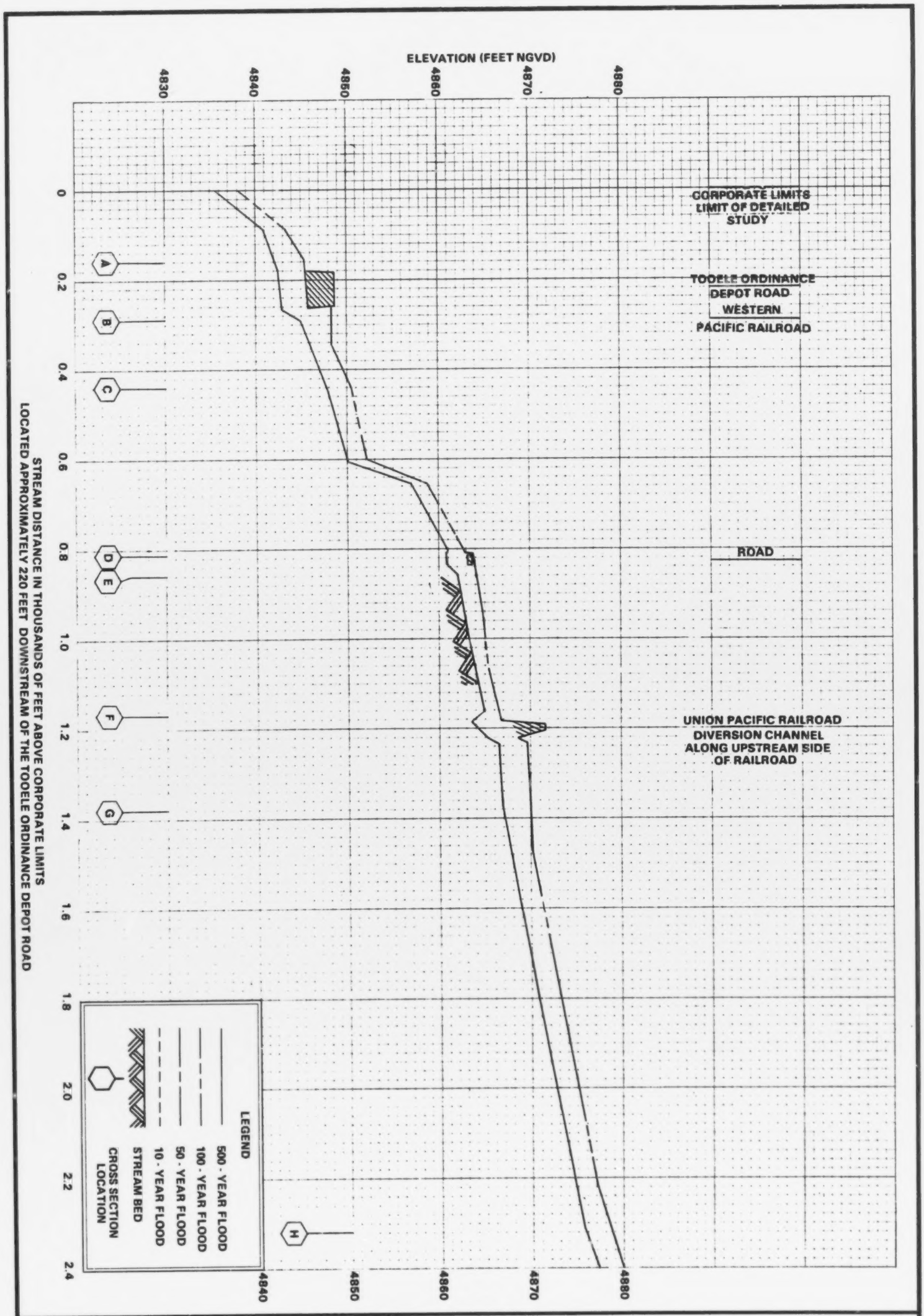


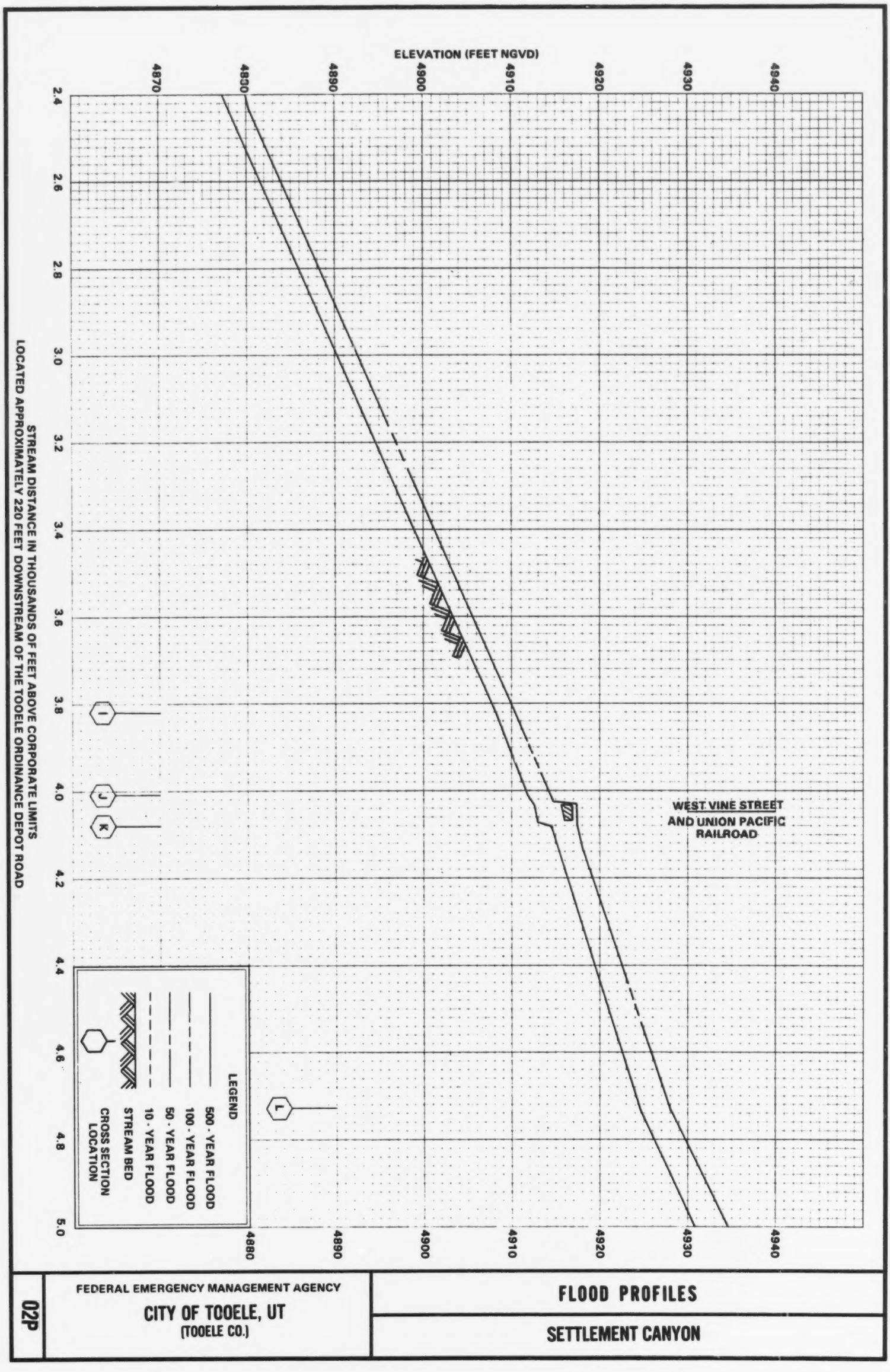
01P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

FLOOD PROFILES

SETTLEMENT CANYON



02P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

FLOOD PROFILES

SETTLEMENT CANYON

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CORPORATE LIMITS
LOCATED APPROXIMATELY 220 FEET DOWNSTREAM OF THE TOOELE ORDINANCE DEPOT ROAD

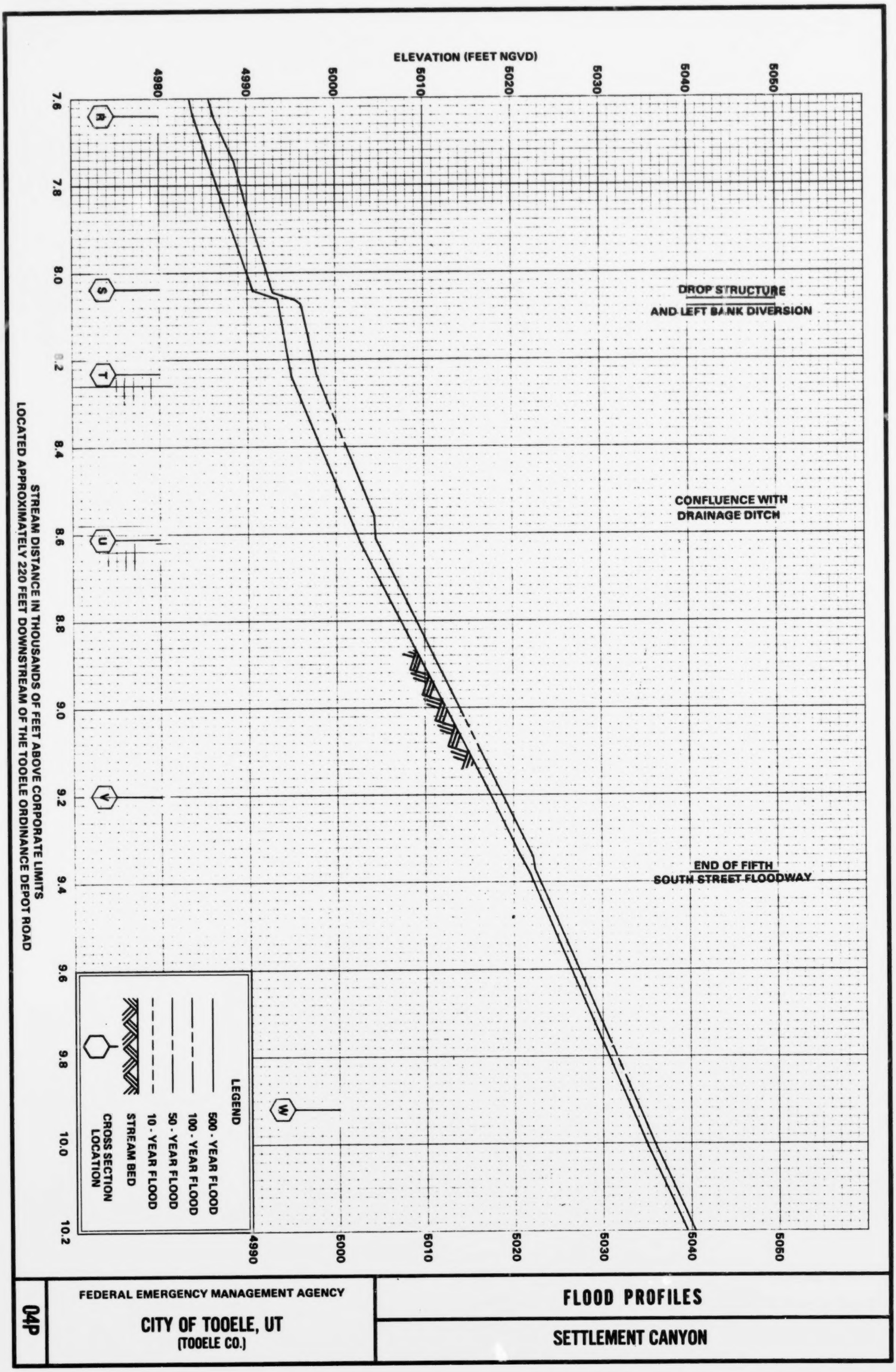
FLOOD PROFILES

SETTLEMENT CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

03P



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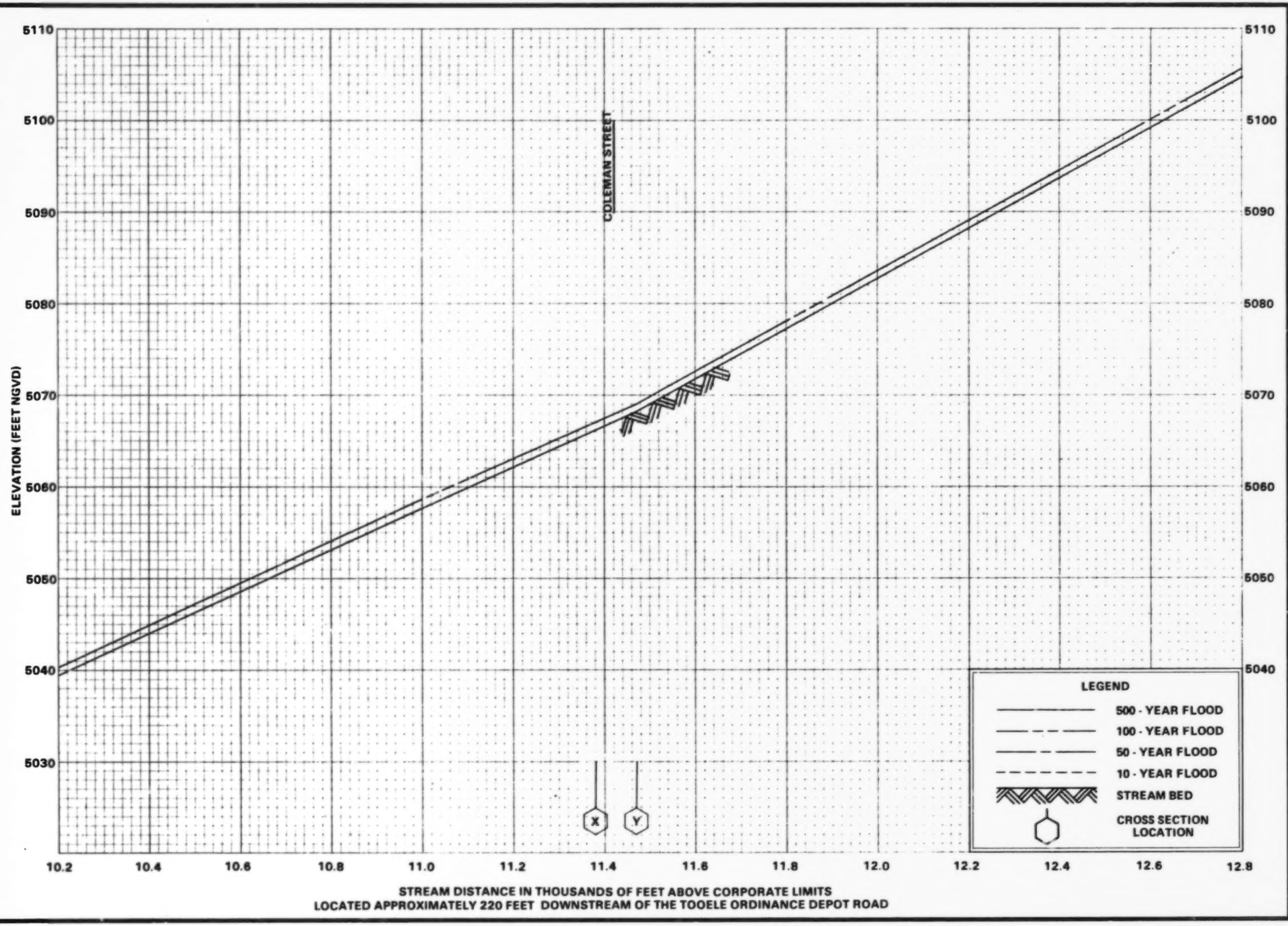
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

FLOOD PROFILES

SETTLEMENT CANYON



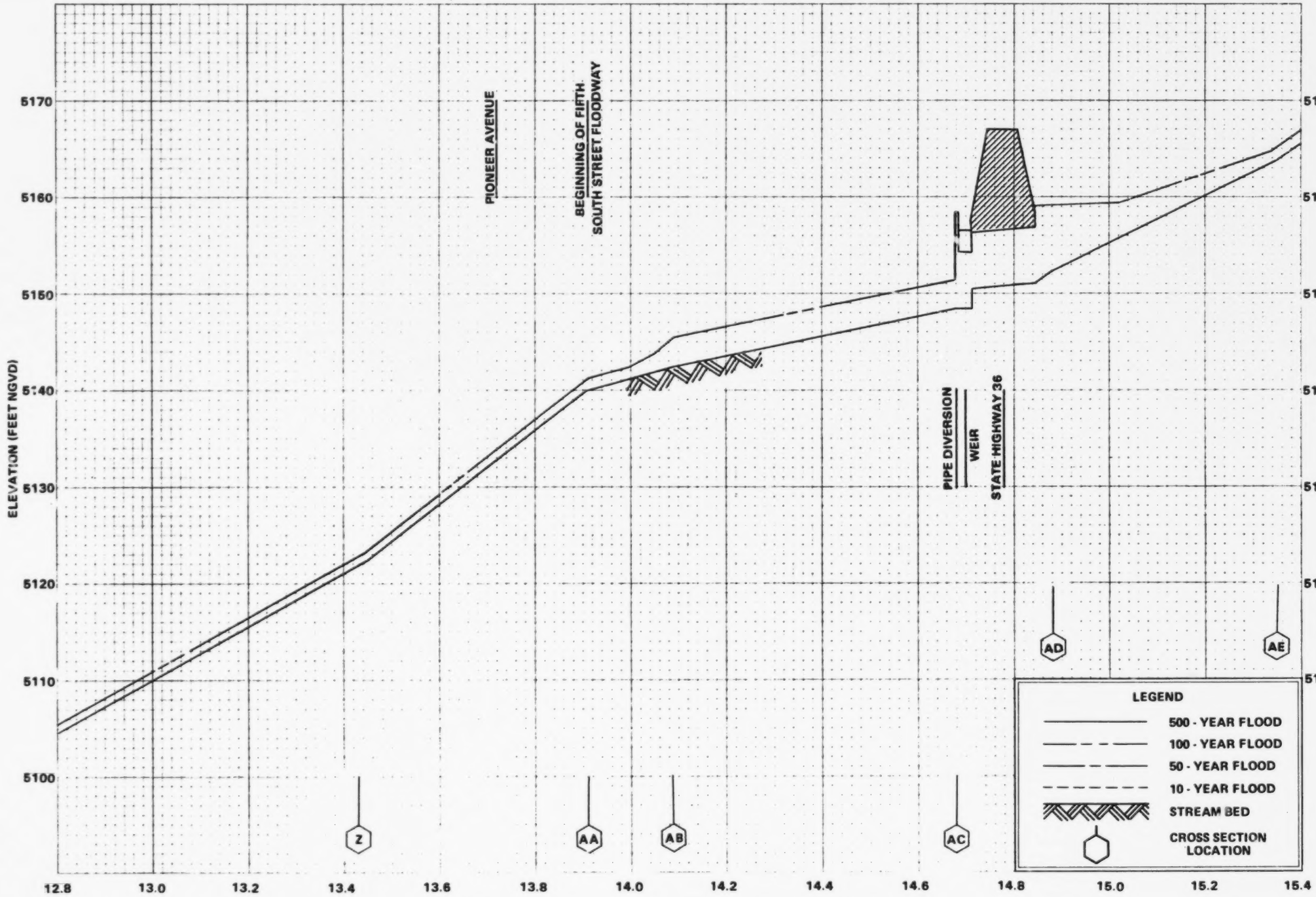
FLOOD PROFILES

SETTLEMENT CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

05P



STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CORPORATE LIMITS
LOCATED APPROXIMATELY 220 FEET DOWNSTREAM OF THE TOOELE ORDINANCE DEPOT ROAD

FLOOD PROFILES

SETTLEMENT CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

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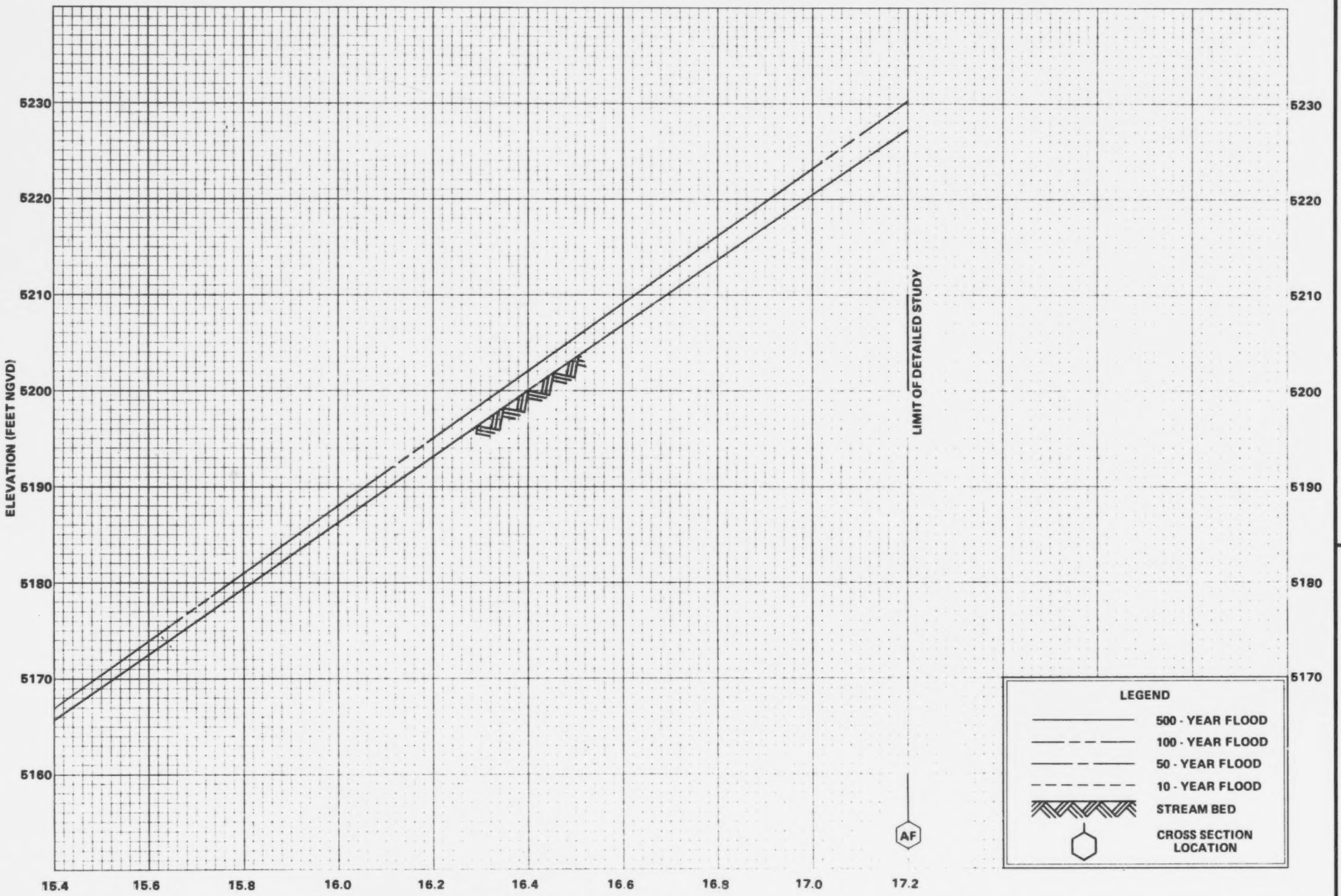

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CORPORATE LIMITS
LOCATED APPROXIMATELY 220 FEET DOWNSTREAM OF THE TOOELE ORDINANCE DEPOT ROAD

FLOOD PROFILES

SETTLEMENT CANYON

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

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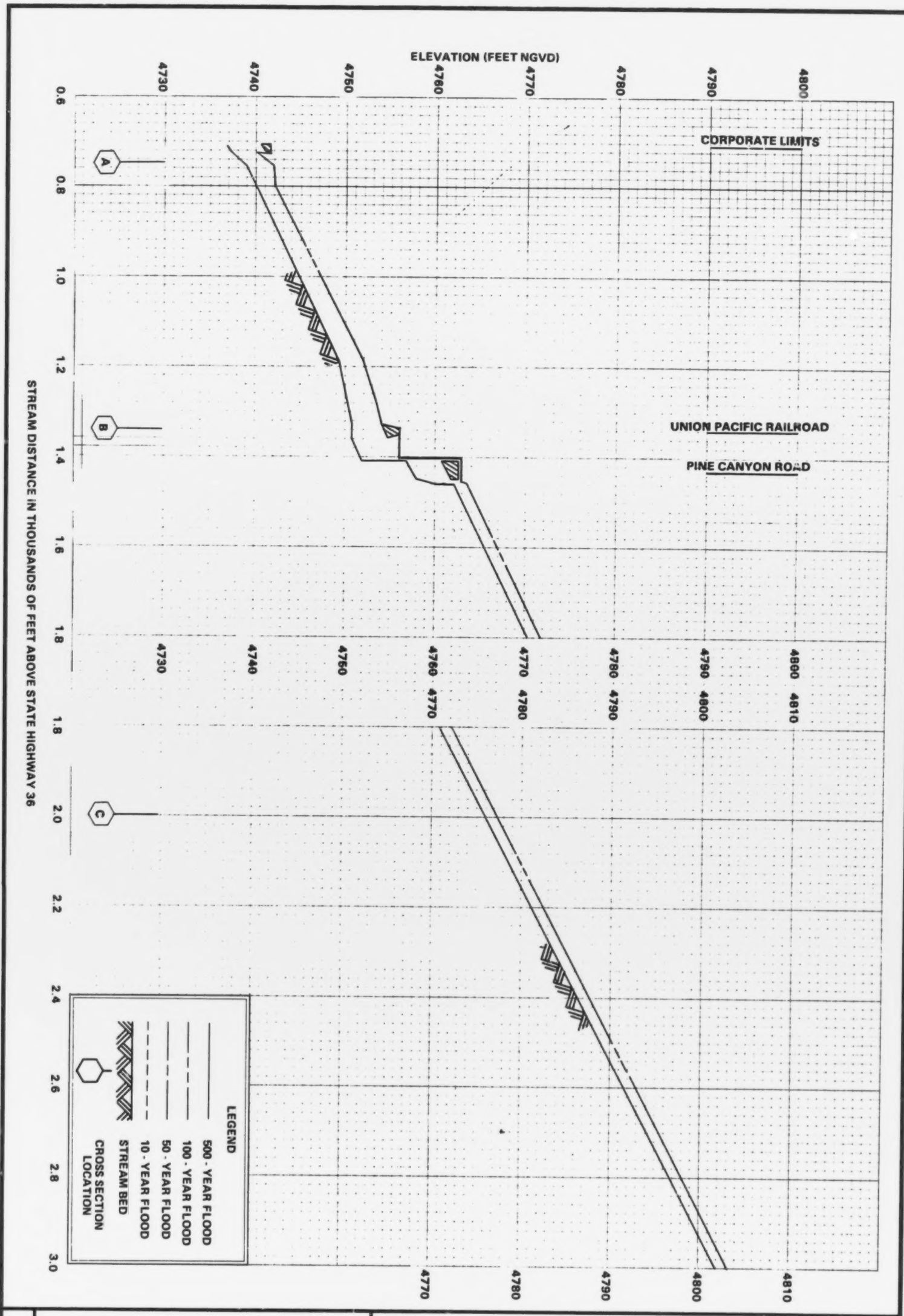

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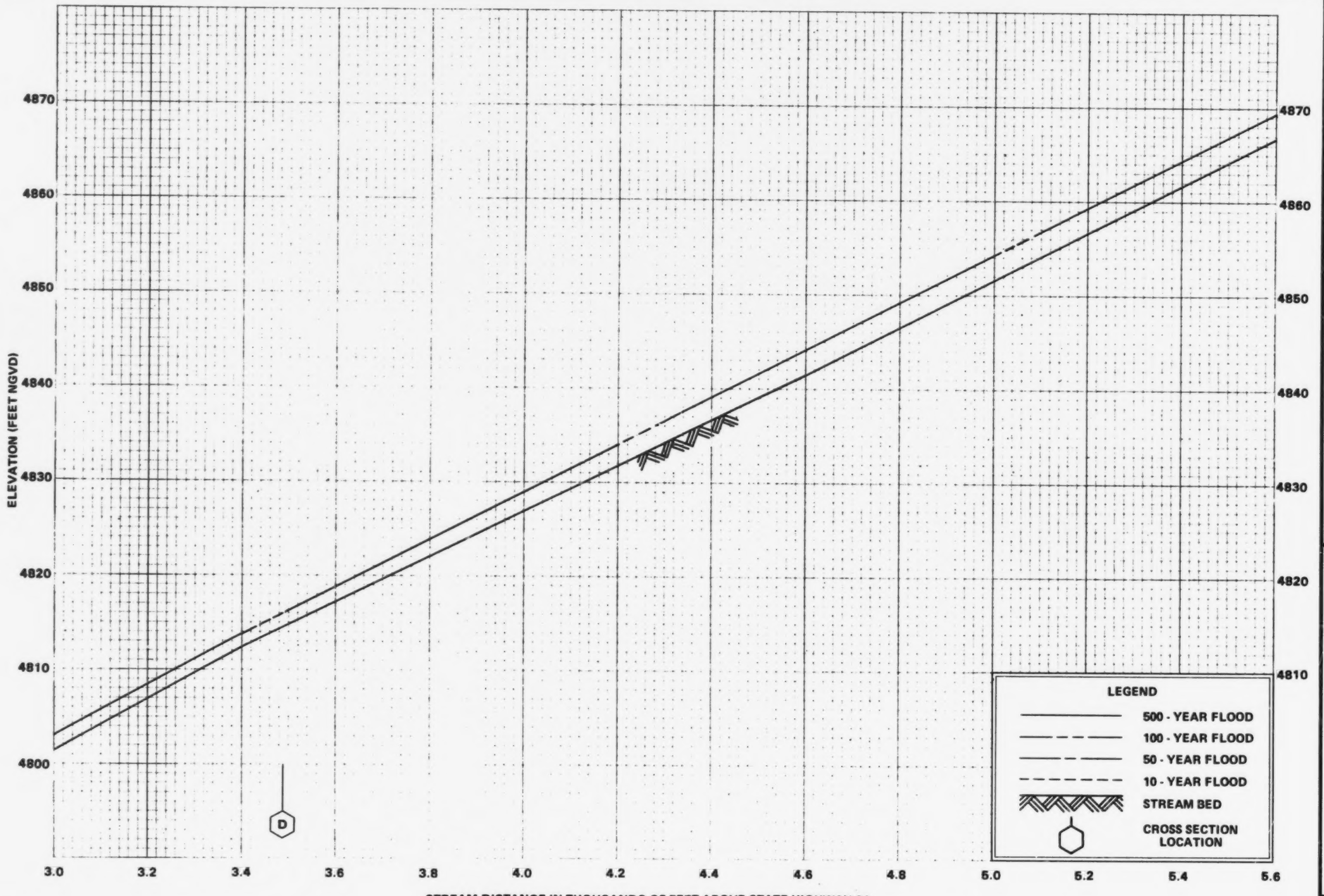
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

FLOOD PROFILES

MIDDLE CANYON CREEK



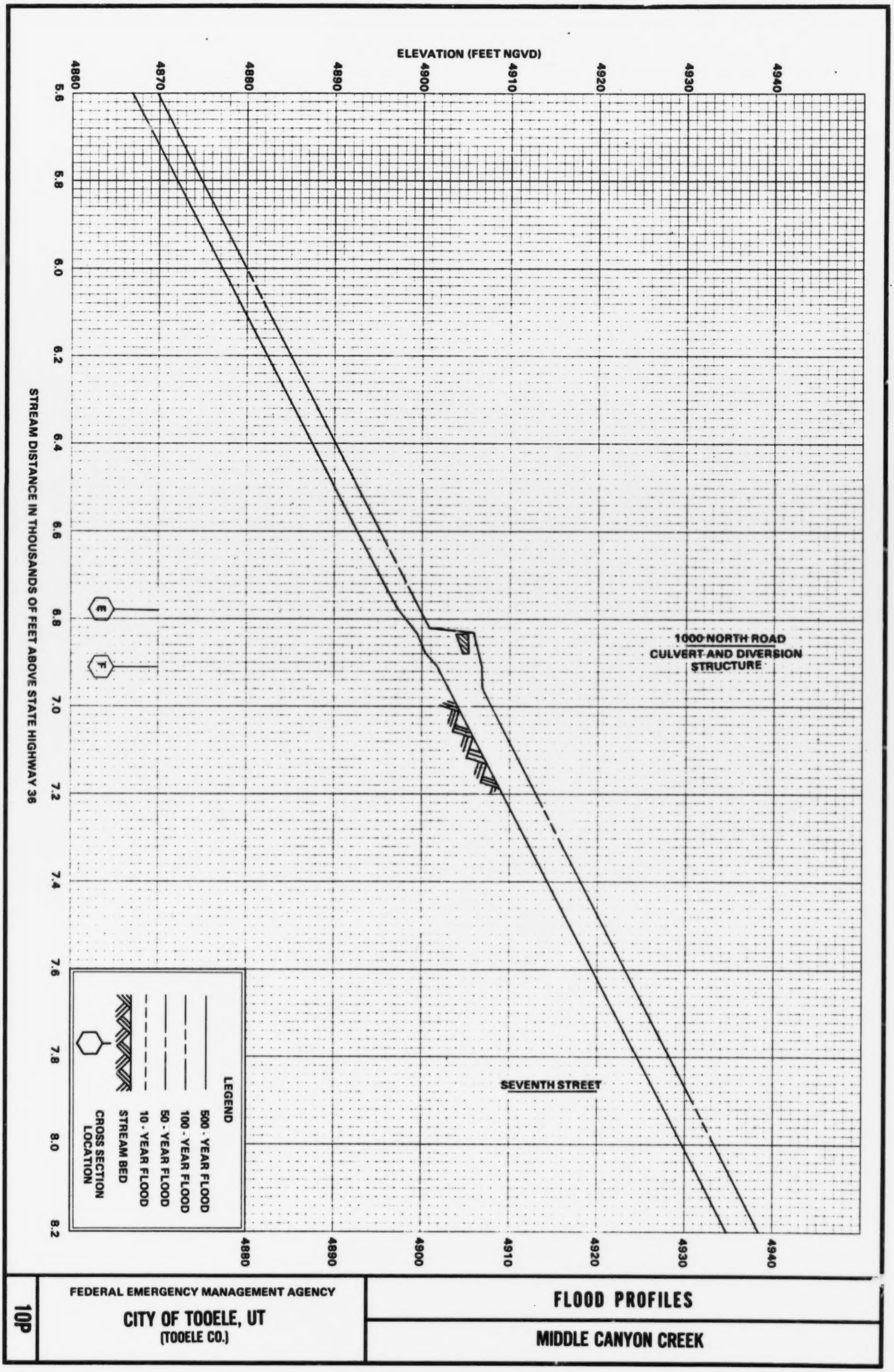
FLOOD PROFILES

MIDDLE CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

09P



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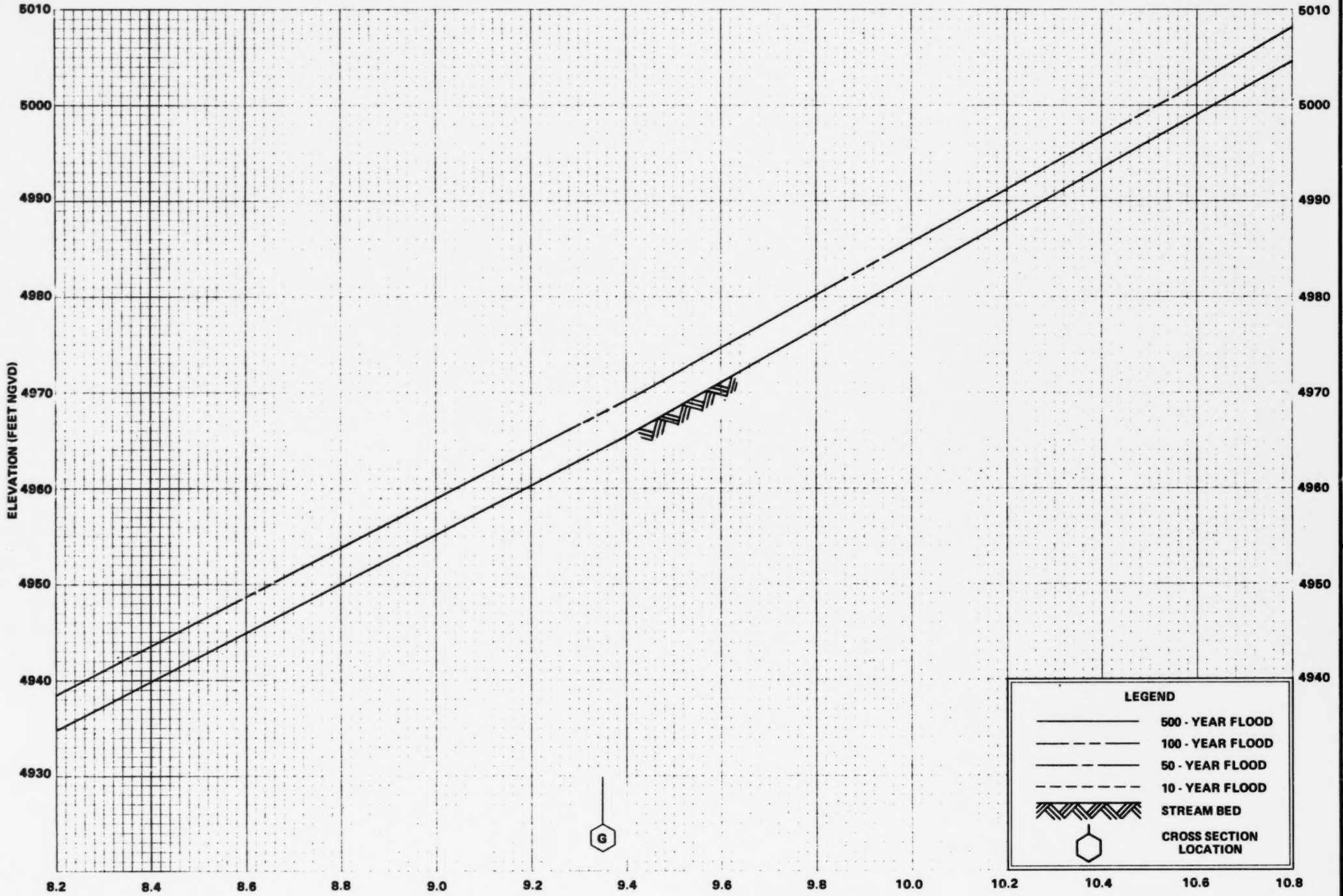
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

FLOOD PROFILES

MIDDLE CANYON CREEK



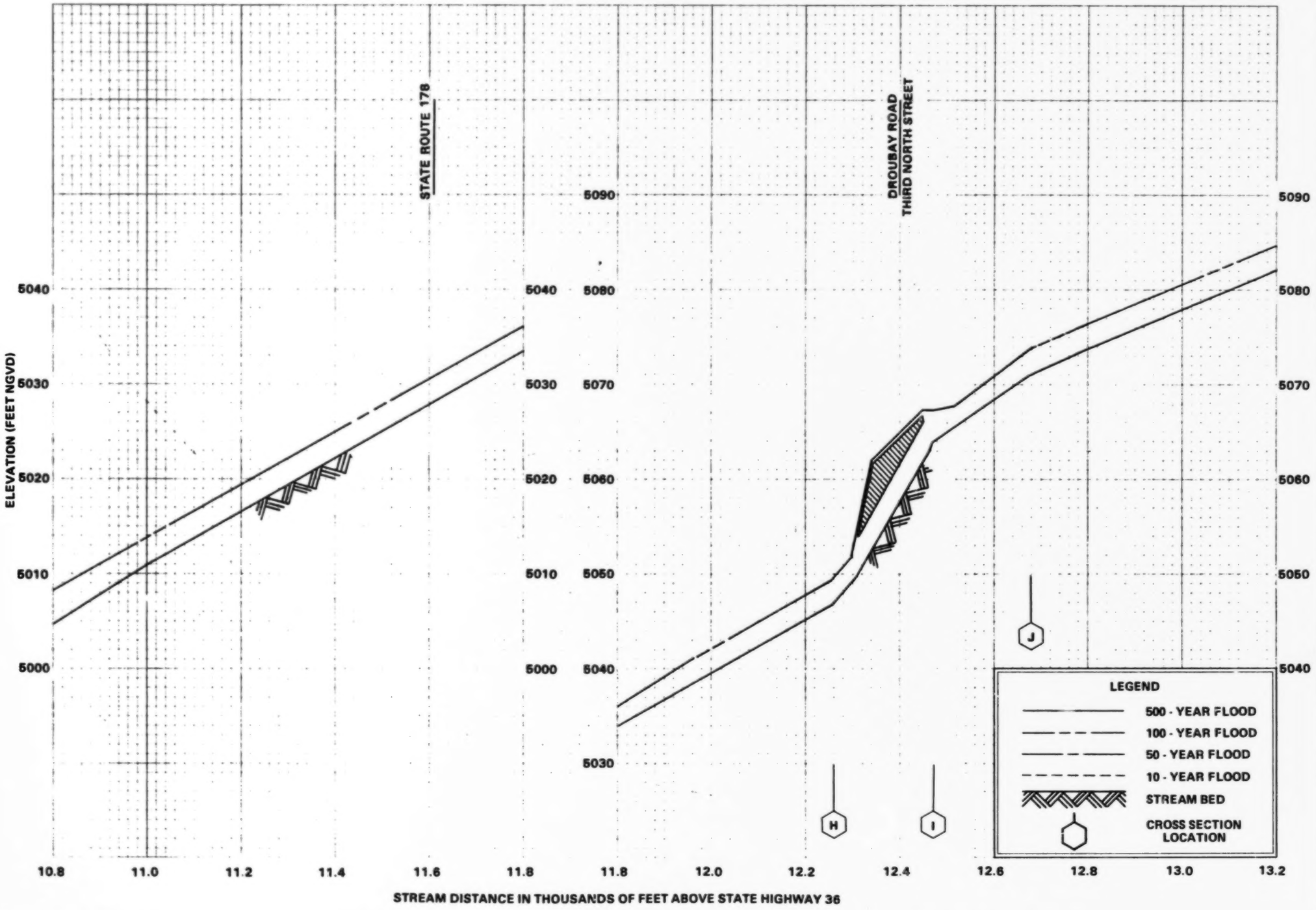
FLOOD PROFILES

MIDDLE CANYON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

11P



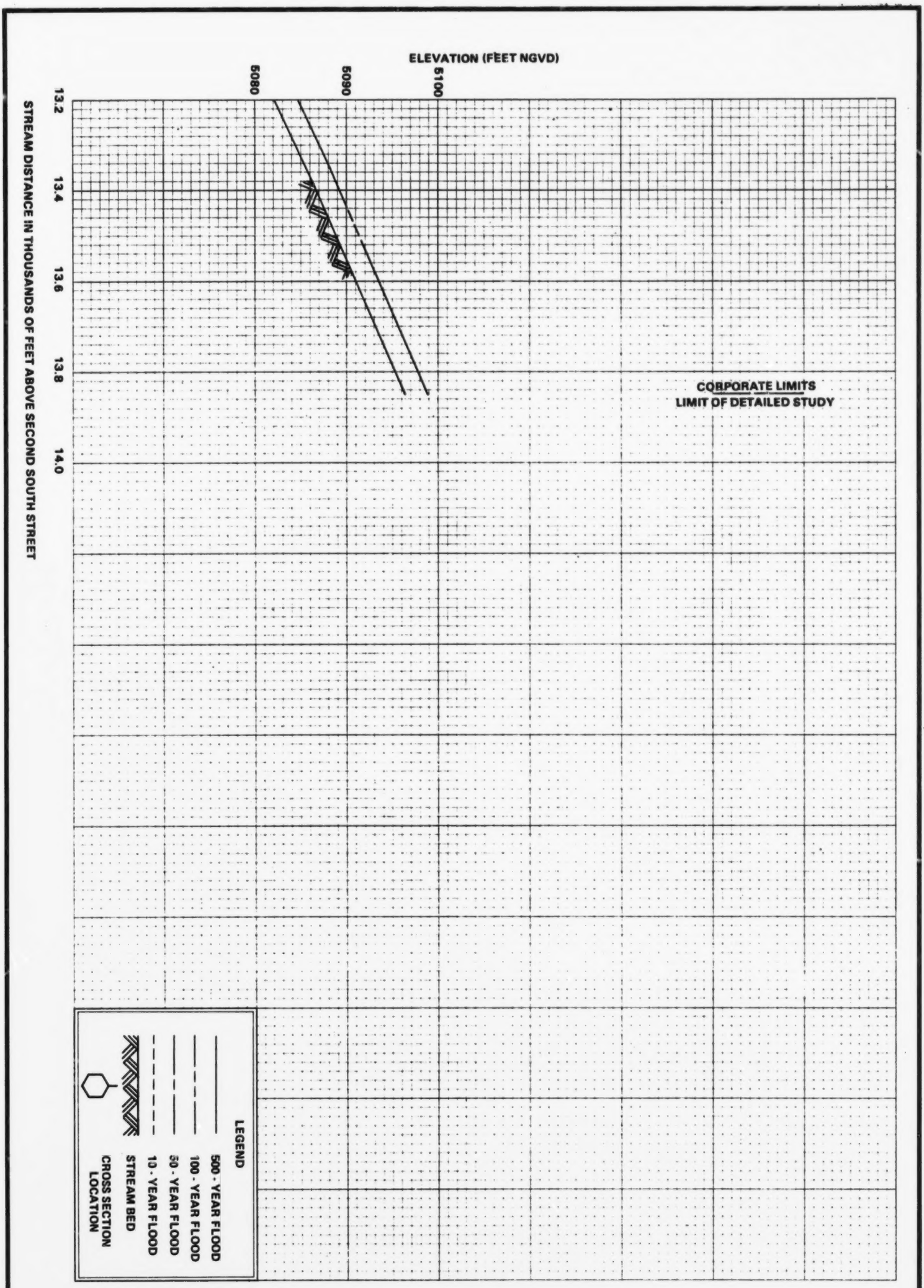
FLOOD PROFILES

MIDDLE CANYON CREEK

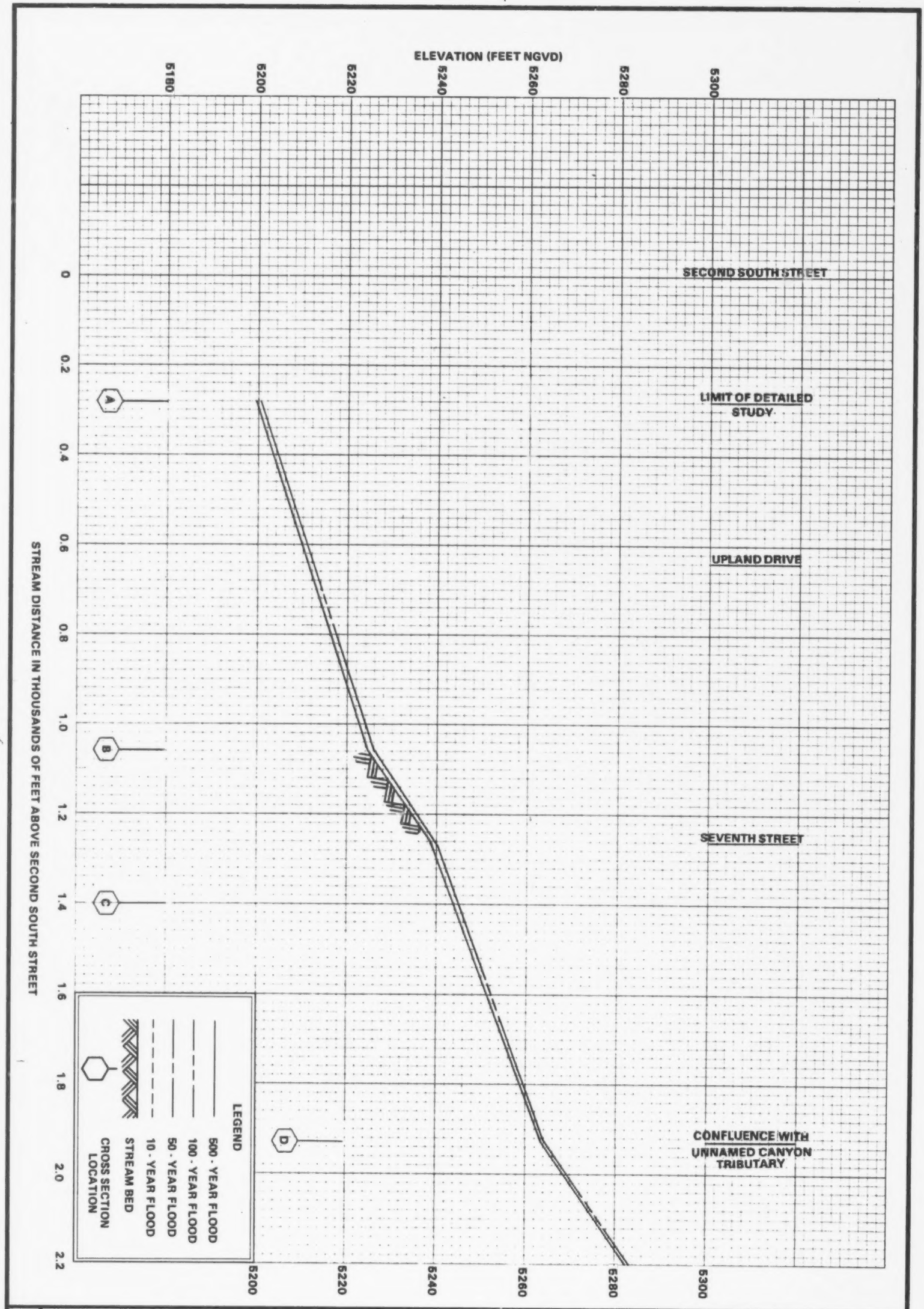
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

12P



13P	FEDERAL EMERGENCY MANAGEMENT AGENCY CITY OF TOOELE, UT (TOOELE CO.)	FLOOD PROFILES MIDDLE CANYON CREEK



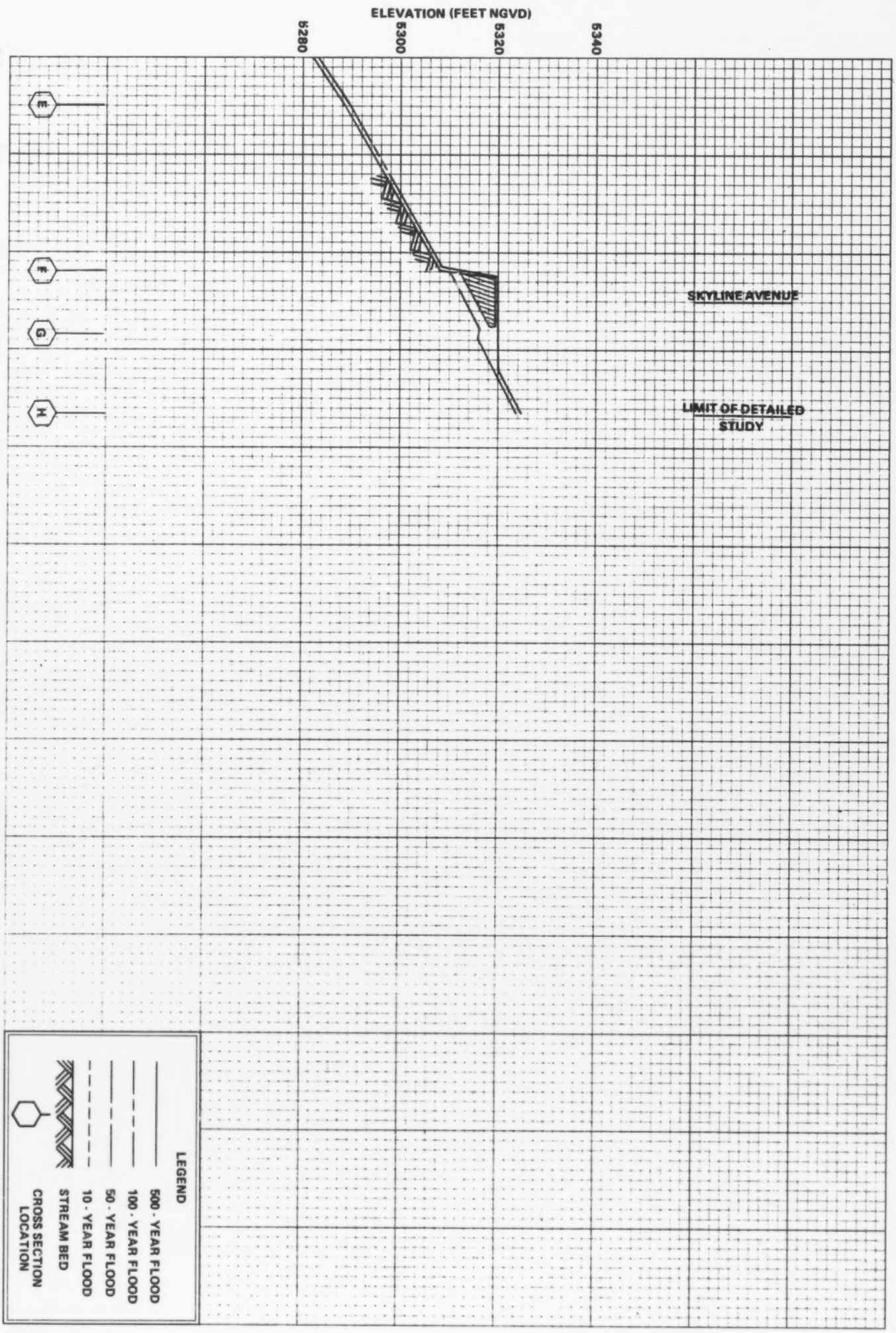
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

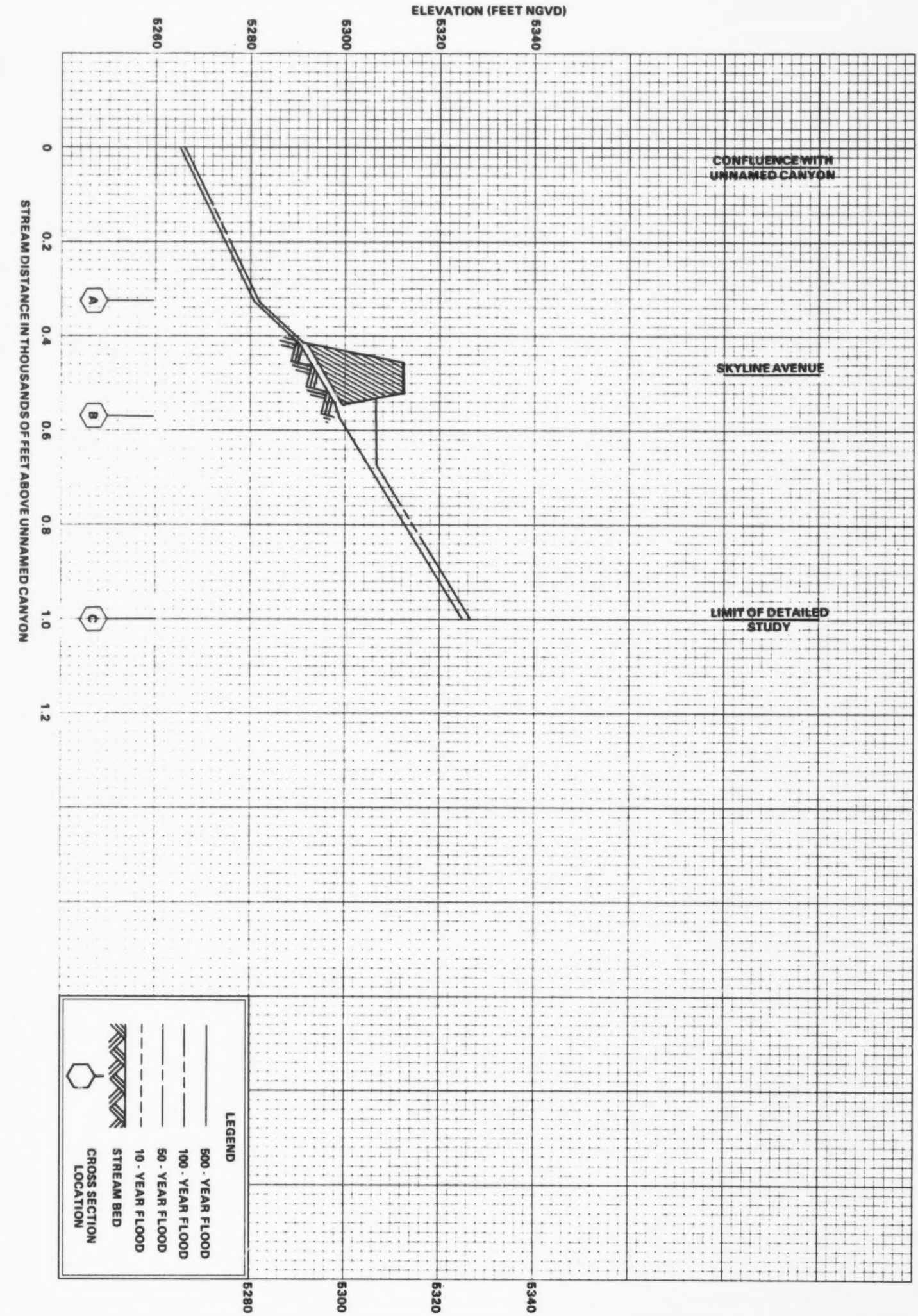
FLOOD PROFILES

UNNAMED CANYON

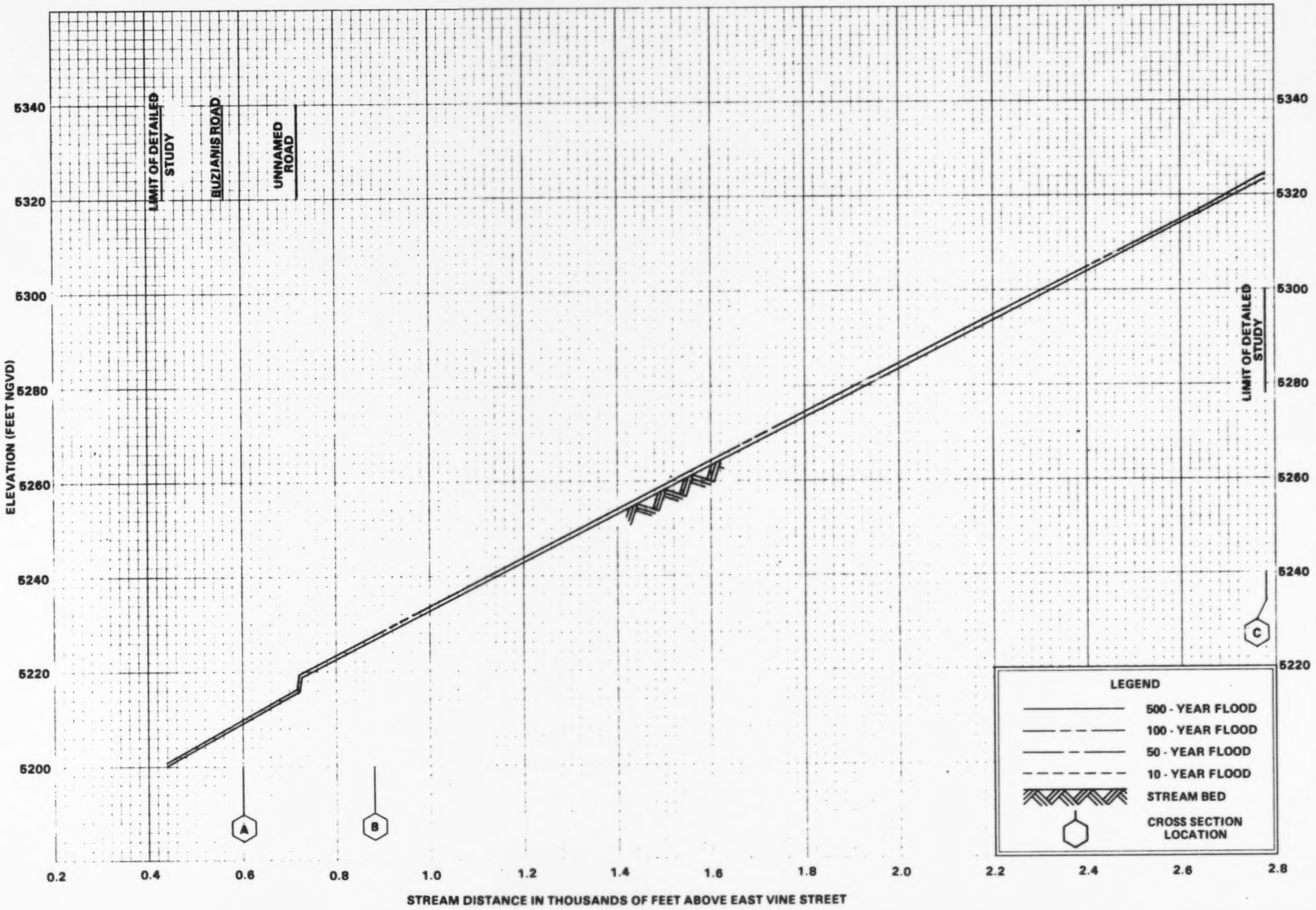
14P



15P	FEDERAL EMERGENCY MANAGEMENT AGENCY CITY OF TOOELE, UT (TOOELE CO.)	FLOOD PROFILES UNNAMED CANYON



16P	FEDERAL EMERGENCY MANAGEMENT AGENCY CITY OF TOOELE, UT (TOOELE CO.)	FLOOD PROFILES UNNAMED CANYON TRIBUTARY



FLOOD PROFILES

UNNAMED CANYON No. 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TOOELE, UT
(TOOELE CO.)

17P

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	Elevation (Feet, NGVD)	Description of Location
RM 1	5,007.52	Nail on top of stake on utility pole No. 21 on right bank of Settlement Canyon just upstream from confluence of right bank drainage ditch, 0.1 mile north of Fifth South Street, and 0.4 mile west of Coleman Street.
RM 2	4,864.61	U.S. Geological Survey Bench Mark H-173, brass cap located on downstream concrete headwall of culvert under Union Pacific Railroad immediately north of Utah Highway 112 (First North Street).
RM 3	5,309.13	Nail in survey stake on utility pole at southwest corner of intersection of Skyline Avenue and Oakridge Drive near Unnamed Canyon Tributary.
RM 4	5,140.18	Chiseled square on southwest corner of concrete diversion and drop structure on Middle Canyon Creek, 400 feet downstream from culvert under abandoned Tooele Valley Railroad, and 0.7 mile east of Seventh Street.
RM 5	5,065.05	Nail in survey stake on utility pole on right bank of Middle Canyon Creek at southeast corner of intersection of Droubay Road and Third North Street, and 0.5 mile east of Seventh Street.
RM 6	4,907.76	Nail in survey stake on utility pole on right bank of Middle Canyon Creek at south edge of 1000 North Street.
RM 7	4,761.32	Railroad spike in utility pole on right bank of Middle Canyon Creek between Pine Canyon Road and the Union Pacific Railroad.

EXHIBIT 3 - ELEVATION REFERENCE MARKS (cont'd)

Reference Marks	Elevation (Feet, NGVD)	Description of Location
RM 8	4,790.38	U.S. Geological Survey Bench Mark J-173, brass cap located on the southeast side of the Union Pacific Railroad, 4,000 feet southwest of Utah Highway 36 overpass. Cap is located 113 feet east and across railroad track from mile post 750.50, 42 feet southeast of southeast rail, 25.6 feet northwest of right-of-way fence, 2 feet northeast of utility pole, and 2.4 feet southwest of witness post.